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Name _____

Date _____

Episode 12 (Part 1): MOTORS, GENERATORS

Part I. Vocabulary Words: Review the given definitions. Define the remaining vocabulary words as you watch [Cog's Episode 12](https://youtu.be/RqXaW9U-b9M): <https://youtu.be/RqXaW9U-b9M>

- **Fossil Fuels** [0:58] like coal, oil, and gas are made of ancient dead things. When we burn them we're releasing ancient carbon into the atmosphere.
- **Internal Combustion Engines** [1:25] burn fossil fuels in our cars and jets.
- **Electric Motors** [2:05]
- **Wire Insulation** [2:40] covers the wire and keeps the electrical current contained.
- **Generators** [4:15]
- **Turbines** [4:26] are machines that spin when wind, steam or water move the blades.
- **Solar Towers** [5:00]
- **Photovoltaic Cells** [5:40]
- **Intermittently** [6:35] means irregularly, not continuously.

Part II. Answer after viewing the video.

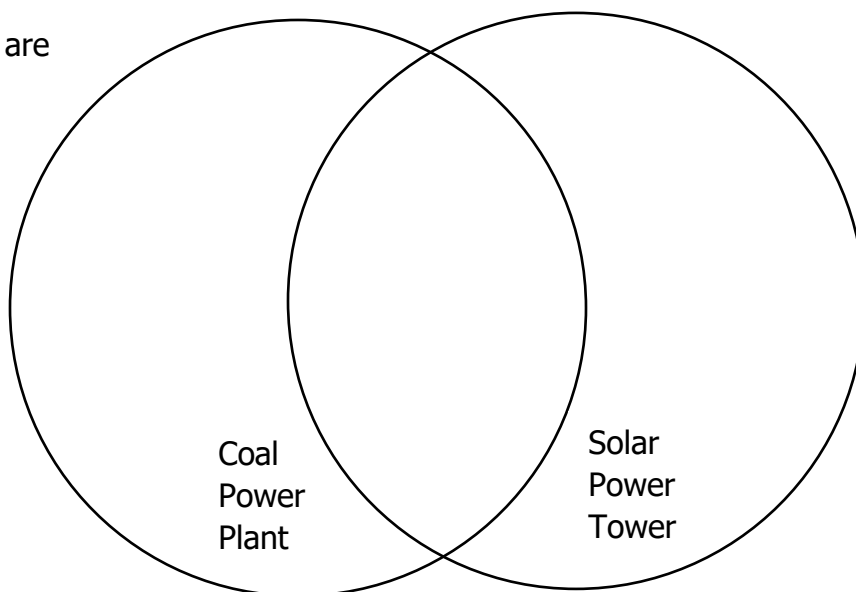
Coal power plants and solar towers are somewhat alike.

Fill in this Venn Diagram to see how they are alike and different.

Use these words:

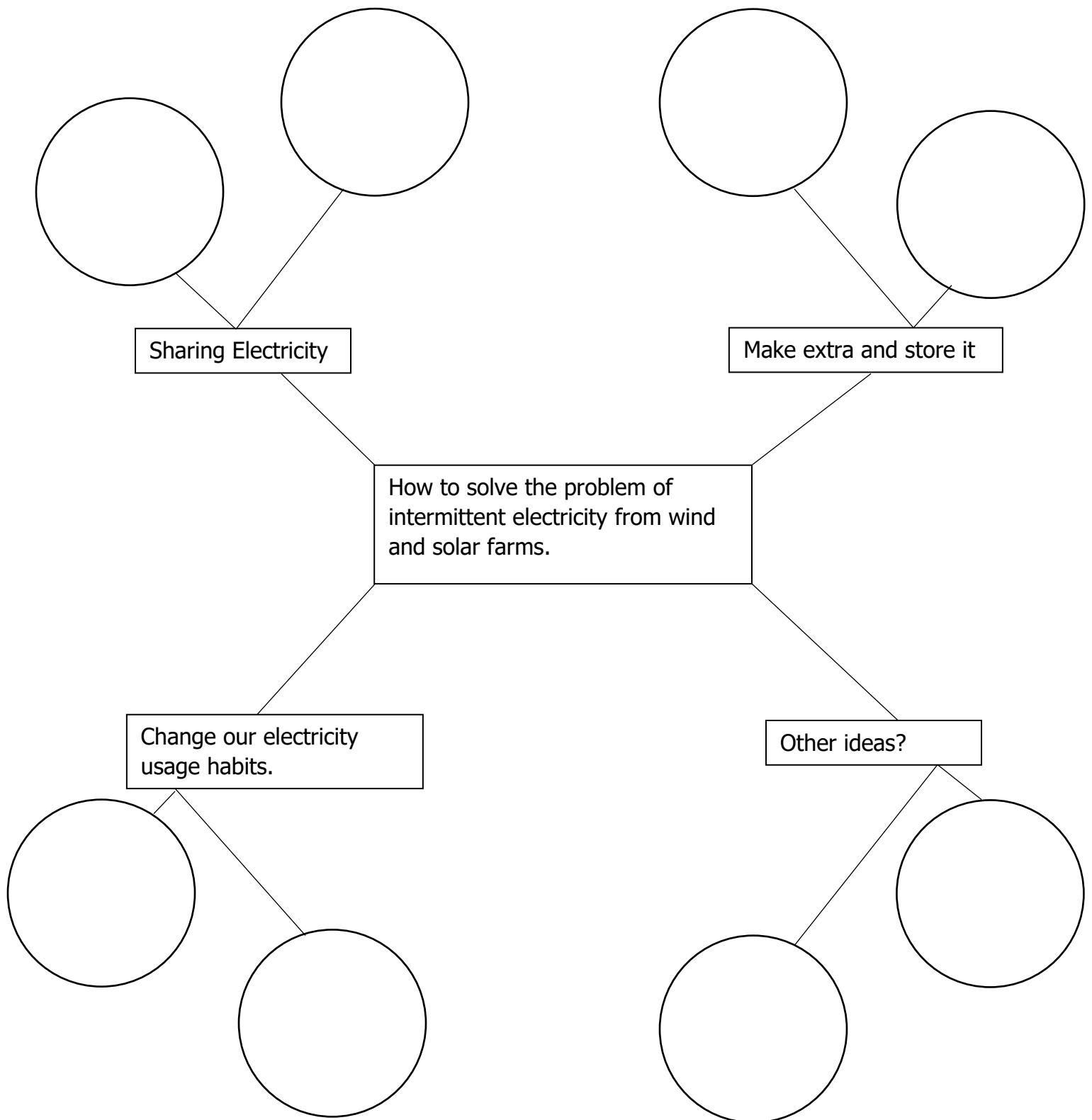
Pollution, Steam, Burns Fossil Fuel, Coal, Sun's Heat, Power Lines, CO₂ produced, Heat, Fuel Is Mined, Turbine, Fuel Is Free, Generator.

Can you think of other words to use in this Venn diagram?



Part III. Think-Pair-Share: Wind and Solar Electricity is produced intermittently, but we use electricity all the time. Brainstorm ways we could solve this problem by filling in as many bubbles as you can.

Note: Power plants that burn coal or oil cannot be turned on and off quickly, so using them as backup is not possible.





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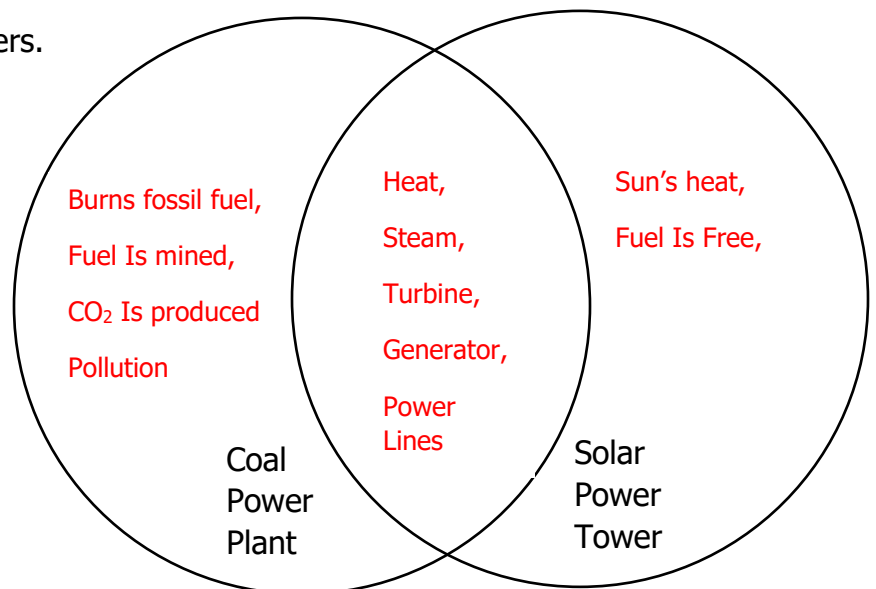
- **Fossil Fuels** [0:58] like coal, oil, and gas are made of ancient dead things. When we burn them we're releasing ancient carbon into the atmosphere.
- **Internal Combustion Engines** [1:25] burn fossil fuels in our cars and jets.
- **Electric Motors** [2:05] **take in electricity and transform it into the mechanical energy of a spinning rotor.**
- **Wire Insulation** [2:40] covers the wire and keeps the electrical current contained.
- **Generators** [4:15] **produce electricity when they are spinning.**
- **Turbines** [4:26] are machines that spin when wind, steam or water move the blades.
- **Solar Towers** [5:00] **use mirrors to focus the sun's light on a tower where a liquid heats up. That heated liquid produces steam that turns a turbine that spins a generator.**
- **Photovoltaic Cells** [5:40] **turn the sun's light energy into electricity directly.**
- **Intermittently** [6:35] means irregularly, not continuously.

Part II. Answer after viewing the video.

Coal power plants are like solar towers.
Fill in this Venn Diagram that shows how they are alike and different.

Use these words: Heat, Steam, Turbine, Generator, Burns Fossil Fuel, Coal, Sun's Heat, Power Lines, CO₂ produced, Fuel Is Mined, Fuel Is Free, Pollution.

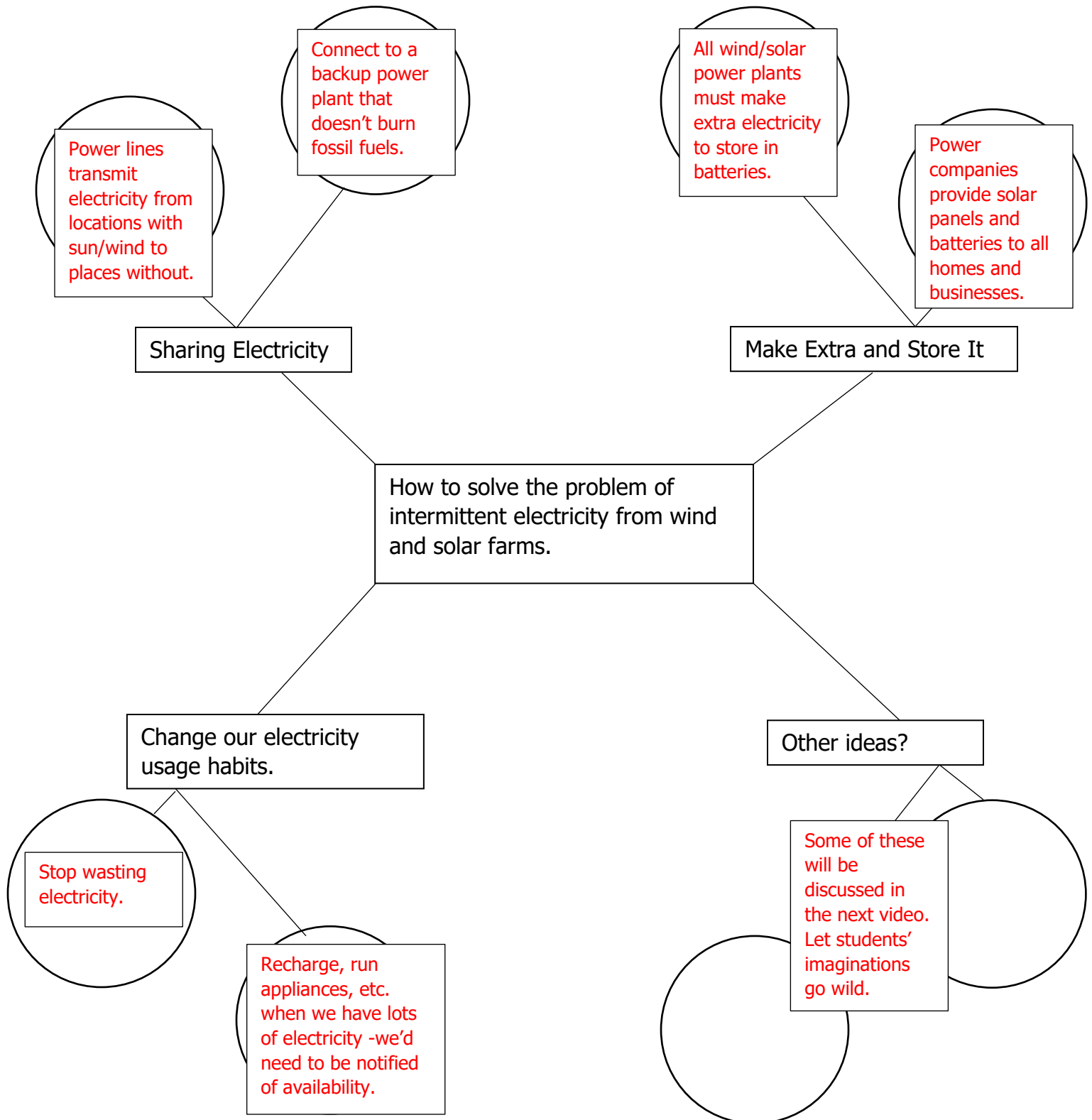
Can you think of other words to use in this Venn diagram?



Name _____

Part III. Think-Pair-Share: Wind and Solar Electricity is produced intermittently, but we use electricity all the time. Brainstorm ways we could solve this problem by filling in as many bubbles as you can. **Answers will vary.**

Note: Power plants that need heat to make steam cannot be turned on and off quickly, so using them as backup is not possible.



TEACHER RESOURCES

NGSS Standards

Middle School NGSS Standards:

[MS-ESS3.C](#): Human activities have altered the biosphere. Human populations and per-capita consumption increases negative impacts unless activities and technologies are engineered otherwise.

[MS-ESS3.D](#): Human activities (releasing greenhouse gases from fossil fuels) are major factors in Earth's temperature rising. Science, engineering, and other kinds of knowledge can help us act wisely to reduce human vulnerability.

[MS-PS2.B](#): Electric and magnetic forces can be attractive or repulsive.

High School NGSS Standards:

[PS3-3](#): Devices that convert one form of energy into another form.

[ESS3.C](#): Scientists and engineers can develop technologies that preclude ecosystem degradation.

Experiment Resources:

Make a model of an electric car:

Visit the amazingly cool website from Arizona STEM Acceleration project that gives great directions for how to build a model of an electric car.

https://docs.google.com/presentation/d/17W0p696Vb3pUOsDMibZBCZNtmbXm8VOv/edit#slide=id.g2b194531f50_0_124

While you're there, visit their GREAT lesson plans for teaching about alternative energy sources, complete with great engineering lesson plans.

https://docs.google.com/presentation/d/1Tb-cJN4_JjQ1oc-Iy8tLtOOy_gbxqnc/edit#slide=id.p1

I used these sites to make an electric motor:

<https://www.wikihow.com/Build-a-Motor>

<https://www.education.com/science-fair/article/no-frills-motor/>

Description: Episode 12 has 2 parts that can be viewed on the same day or on separate days. They stand alone, so you could even choose to watch just Part 1 or just Part 2. If you choose to watch Parts 1 and 2 on the same day, you could do vocabulary from both worksheets and then choose activities from the worksheets to fill out your class period.

Part 1 Worksheet: This worksheet supplements [Episode 12: Electrify Everything Part 1: Evs, Motors, Generators, and Turbines](#) (<https://youtu.be/RqXaW9U-b9M>)

It can be used by teachers or their substitutes (given the answer key) to guide learning, check for understanding, and interpret the significance of the information in students' lives.

The first page asks questions that can help students recall and understand the material covered in the video. The second page helps students connect the information to their own lives and evaluate or infer meaning by pondering the importance of the information. Pages can be used separately or printed front-to-back.

Directions:

Before viewing the video, hand out a worksheet to each student if being done individually or a worksheet to each group of 2-4 students if they're working in groups.

Part I -Vocabulary

Some vocabulary words have been defined and should be discussed before viewing the video. The remaining vocabulary words can be defined as you watch the video. The timestamp next to each word indicates where the word is used. Stop the video and replay as many times as needed. If students need help, give them the definitions from the answer key.

Part II Venn Diagram

Ask students to recall information about solar towers and coal power plants from the video. It may help to refresh their memories to show them the drawings of the solar power tower [5:00] and the coal-fired power plant [5:22] in the video or on page 8 of this document. Allow them 5 minutes to place the given words in the Venn diagram and think of other words. If time permits, share student answers. Ask students to jot down any new information they've gathered from your discussion.

Part III Think-Pair-Share

Ask students to think of strategies they might use if they knew their water bottle might not hold enough water for a long hike or soccer game. They might come up with ideas to **buy** water from someone with lots of water when they ran out. They could bring an extra water bottle and **keep it stored** in a backpack for later. They could **carefully allot** their water so they didn't run out. Those strategies can also work for scarce electricity.

Ask them to think of some ways we could make sure we don't run out of solar or wind electricity. Give them 2 minutes to think of ideas on their own. Then ask students to pair up with another student to share what they thought of and come up with new ideas together for 5 minutes. Afterwards, ask students to share their best solutions with the class if time allows. By the end of the activity, most of their bubbles should be filled in. If not, talk about the solutions given in the teacher's key. Could any of those solutions help?

WATCH RELATED COG VIDEOS ABOUT THE CARBON CYCLE:

The fast carbon cycle:

- [Episode 2: Cellular Respiration & the Fast Carbon Cycle](#) (Food becomes CO₂ and H₂O.)
- [Episode 3: Campfires](#) (How plants burn, releasing CO₂ and water.)
- [Episode 8: Photosynthesis](#) (How plants turn CO₂ and water into food.)
- [Episode 9: Oceans](#) (How carbon moves through a food web or pyramid.)

The slow carbon cycle:

- [Episode 7: Volcanoes and CO₂](#) (How volcanoes form and release CO₂)
- [Episode 10: The Slow Carbon Cycle](#) (How CO₂ is absorbed into oceans from atmosphere, incorporated into shells, falls as sediment, lithifies into rock, and releases CO₂ when heated (volcanoes or cement production) or chemically eroded.)

Moving fossil fuels from slow carbon cycle into fast carbon cycle:

- [Episode 1: Carbon Dioxide: A Greenhouse Gas](#) (Intro to climate change.)
- [Episode 4: Coal-Fired Power Plants](#) (How coal forms and is burned as a CO₂-generating heat source to create steam that turns a turbine and generator to produce electricity.)
- [Episode 5: Crude Oil Fuels](#) (How crude oils (petroleum) form, are refined, and burned as transportation fuels that release excess CO₂ into the atmosphere.)
- [Episode 6: Natural Gas and Methane](#) (How natural gas, which is mostly methane, forms and is burned to produce heat, also releasing excess CO₂. Includes fracking info.)

Climate Change Solutions

- [Episode 11: A Climate Call to Action](#) (Shows how much CO₂ we're actually producing, why that causes climate change, how climate change will affect us, and what we can do about it.)
- [Episode 12 \(Part 1\): Electrify – EVs, Motors, Generators, and Turbines](#) (Builds a model of an EV and a model of an electric motor. Shows that EVs already produce CO₂ than gas-powered cars, but will be better when we recharge with CO₂-free electricity.)
- [Episode 12 \(Part 2\): Electrify - Solutions](#) (Addresses battery storage and other back up systems we can use to supplement intermittent electricity generated by wind and solar, as well as listing constant energy sources we can use. Gives ideas for how students can help combat climate change.)

Electric Vehicles (EVs)

Electrical energy is transformed into mechanical energy of a spin in the motor

Look! It's just wires and magnet.

Inside the motor:

Bird's eye view of the car

Wind and Solar Energy

Enough of my energy in 1 hour to power Earth for 1 year!

Solar Energy

Photovoltaic cells or panels turn light energy into electricity.

A solar tower focuses sun's heat energy using mirrors

Wind Energy

A turbine spins the generator to make electricity

Electricity in Motor: Spin out magnets copper coils

Electricity out Generator: Spin in

ELECTRIFY
 (almost) EVERYTHING!

Electricity

Thermoelectric Power Plant

Bulb

Wire

Generator

Steam Turbine

COAL

Yum!